Anisotropy Pinning Effects in Superconductors beyond J_c

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Big Science Projects act as a technology driver for coated conductors that benefit either from intrinsic isotropic materials like LTS (e.g. NbTi for LHC@CERN and Nb_3Sn for ITER) or *effective* isotropic pinning materials like HTS for magnetic confinement in Fusion Energy.

This study examines the potential of Iron-Based materials, specifically Fe(Se,Te) thin films for coated conductors technology, by disentangling intrinsic anisotropy and pinning effects through angular transport measurements beyond J_c, complemented by detailed microstructure analysis. The aim is dual: attaining high vortex velocities pushing towards the operating limits of any superconducting device and gaining a deeper understanding of vortex and quasi-particle dynamics under extreme out-of-equilibrium conditions. Indeed, a deep knowledge of material anisotropy can boost high-speed limits of vortex motion and possible control of quenching currents beyond J_c [1-4], which are crucial aspects for selecting superconductors for specific applications (e.g. high field magnets, Fault Current Limiters, Photon Detectors).

A comparison with other superconductors such as BSCCO (2D-like) and YBCO (3D-like) materials in the framework of the 3D anisotropy Ginzburg-Landau model as well as the 2D Tinkham's approach unveils the dimensionality of the Fe(Se,Te) compound, its intrinsic anisotropy [5], its anisotropy of vortex dynamics [1] and its pinning anisotropy [2,3]. Additionally, TEM microstructure analysis of IBS-Fe(Se,Te) material defects, which mimic the layered nature of HTS-YBCO, shows its characterization as "*Lego-block"* material [5].

References

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Acknowledgments

Work supported by MUR-PRIN project "QUESTIONs" - grant no. P2022KWFBH. G. G. acknowledges support for measurement equipment by PON Research and Competitiveness 2007-2013 under grant agreement PON NAFASSY, PONa3_00007.